

VII. Precautions in Handling Potassium Carbonate

potassium carbonate are recognized as OSHA hazardous substances. This chemical material is alkaline and may cause severe irritation by all routes of exposure.

Before starting to work with PotCarb, the user should be aware of its properties, understand what safety precautions to follow, and know how to act in case of contact. Some general guidelines are listed below.

- ◆ Read and understand the current MSDS for complete and updated information.
- ◆ Locate and periodically check eyewash fountains and safety showers in all areas where potassium carbonate is handled.
- ◆ Seek medical attention immediately after first-aid measures are applied.

ROUTES OF EXPOSURE

PotCarb can be irritating to the **skin** and to a severe degree if in contact with the **eyes**. Tissue destruction may follow if not properly treated. **Inhalation** of air-borne concentrations of dust, mist or spray may cause damage to the upper respiratory tract and even to the lung tissue which could result in chemical pneumonia, depending upon the severity of exposure.

Ingestion may cause irritation to the mucous membranes of the mouth, throat, esophagus and stomach, with severity dependant on the quantity involved.

There are no known **chronic** effects associated with potassium carbonate. However, **acute** consequences may occur, depending on the

length of exposure and whether proper treatment is rendered in a timely fashion.

OVERVIEW OF FIRST AID MEASURES

Immediately administer the first aid measure described below, then seek professional medical attention.

Eyes - Flush eyes with large amounts of water for at least 15 minutes, holding lids apart to ensure flushing of the entire surface. Washing eyes within several seconds is essential to achieve maximum effectiveness.

Skin - Wash contaminated areas with plenty of water. Remove contaminated clothing and footwear. Do not remove goggles if the eyes are not affected. Wash clothing before reuse. Discard footwear which is contaminated on the inner surface.

Inhalation - Remove to fresh air. If breathing is difficult have a trained person administer oxygen. If respiration stops give mouth-to-mouth resuscitation.

Digestion - Never give anything by mouth to an unconscious person. If swallowed, do not induce vomiting. Give large quantities of water or several glasses of milk if available. If vomiting occurs spontaneously, keep airway clear.

PROTECTIVE EQUIPMENT

OSHA requires employers to supply protective equipment for employees. When handling potassium carbonate, the following protective equipment is recommended:

- ◆ Wear suitable goggles for eye protection during the handling of potassium carbonate in any form. The goggles should be close-fitting to prevent the entry of liquids, yet provide adequate ventilation to prevent fogging.
- ◆ Wear gloves coated with rubber, synthetic elastomers, PVC or other plastics to protect the hands while handling potassium carbonate. Gloves should be long enough to cover well above the wrist.
- ◆ Potassium carbonate causes leather to disintegrate. For this reason, wear rubber boots. Wear the bottoms of trouser legs outside the boots. Do NOT tuck in.
- ◆ Wear cotton clothing for some protection of the body. Wear rubber aprons or a rain suit for additional protection.
- ◆ Wear shirts or jackets with long sleeves and with the collar tightly fastened.
- ◆ Wear hard hats to aid in the protection of the head, face and neck.
- ◆ Wear NIOSH-approved respirators for protection from dusts and mists.

Additionally, care should be taken to avoid the simultaneous presence of potassium carbonate and lime dust. This chemical combination when in contact with moisture in the form of water or perspiration will cause the formation of a very irritating and corrosive material, namely caustic potash (KOH). Workmen must carefully wash and remove dust from one of these chemicals before working in an area where the other chemical is being handled.

VIII. Handling of Anhydrous Potassium Carbonate

A. BAG AND DRUM HANDLING

An efficient system for unloading bagged or drummed potassium carbonate depends on the volume to be handled and the distance it must be carried. Lightweight two-wheel hand trucks, with a wide lip on which bags are laid horizontally, are commonly used where a small volume is involved. Larger tonnage may justify roller conveyors, either freeturning or powered, or portable belt conveyors. Power lift trucks and pallets may be used to store bags or drums and distribute them to points of usage.

Bags should be piled flat to avoid package distortion and load insecurity. Since potassium carbonate is hygroscopic, the best possible storage conditions should be provided. Damp floors, leaky roofs, and moist storage conditions in general must be avoided. Moisture absorption will cause lumping of potassium carbonate and consequently a reduction in

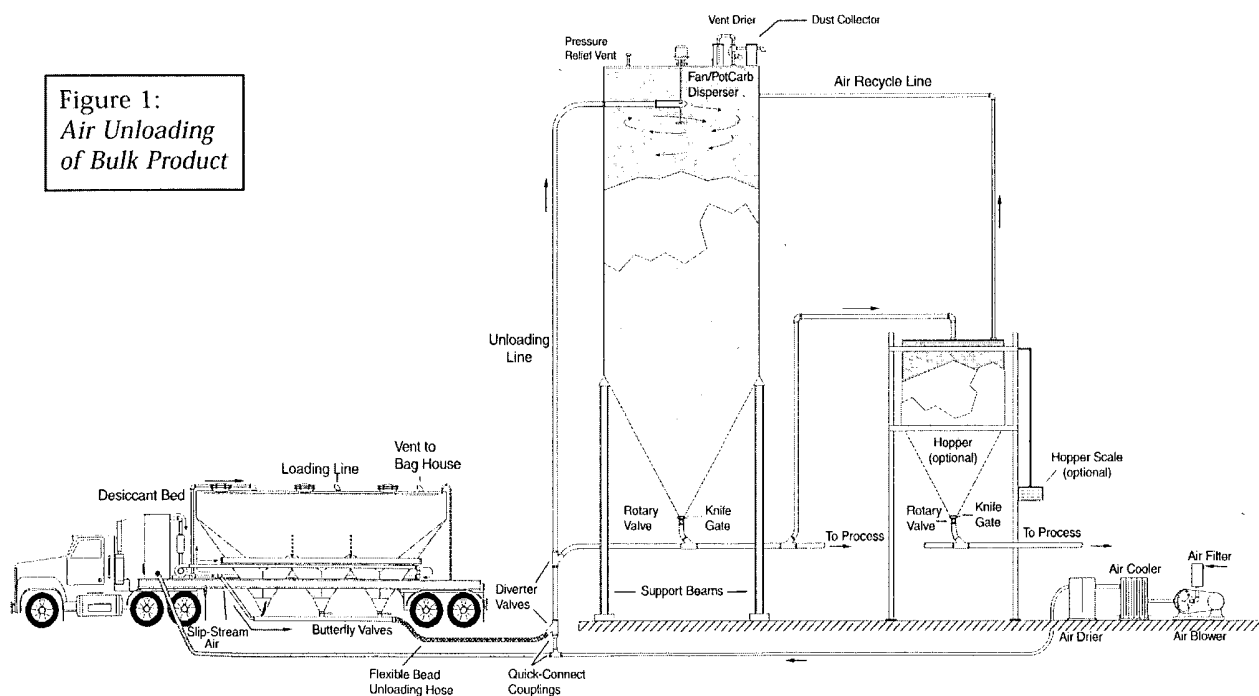
the alkalinity. To minimize this condition, the quantity of material stored should be limited and the oldest material should be used first. For drum users, a good in-plant practice is to keep the cover secured except when withdrawing material. This minimizes moisture pick-up by the hygroscopic potassium carbonate.

BULK MATERIAL HANDLING

Granular anhydrous potassium carbonate can readily be transferred in a conventional conveying system or a pneumatic conveying system. In a conventional system, atmospheric conditions have only a negligible effect on moisture pickup during product handling. However, the anhydrous material must be shielded from rain and snow. It is recommended that the product be transferred in one continuous operation and used before caking occurs.

In pneumatic conveying (**see Figure 1**), potassium carbonate

Figure 1:
Air Unloading
of Bulk Product



may be transferred from truck or rail car with ambient air in dry climates (low dew points). In humid (high dew point) areas like the Mississippi Valley and coastal regions, dry air for pneumatic transfer is suggested. For in-plant pneumatic transfer of anhydrous potassium carbonate, it is always advisable to use clean, dry air.

In preparing for receipt of anhydrous potassium carbonate by bulk hopper car, provisions should also be made to receive emergency shipments by bulk truck. In addition, it is strongly recommended that a roof be provided over the bulk transfer area to provide protection from the weather.

Armand Products' Technical Service is available to assist the customer in selecting the most advantageous method to receive potassium carbonate and to supply information on equipment in the material handling field.

B. MECHANICAL SYSTEMS

This type of transfer equipment consists of a belt or screw conveyor in combination with a bucket elevator or a drag flight chain conveyor. A schematic diagram of this equipment is given in

Figure 2. A permanent undertrack unloading system is recommended when bulk rail receipts are at least 800-1,000 tons per year. A portable above track conveying unit is recommended where bulk material receipt is only 400-500 tons per year.

The **screw**

conveyor is versatile, relatively inexpensive, simple to maintain and readily made dust-tight. It can convey horizontally, vertically, or on an incline and can be fitted with multiple inlet and discharge openings. Screw conveyors are not usually used for long-distance movement and are limited in length to 50-100 feet. The grinding action of a screw conveyor on friable materials

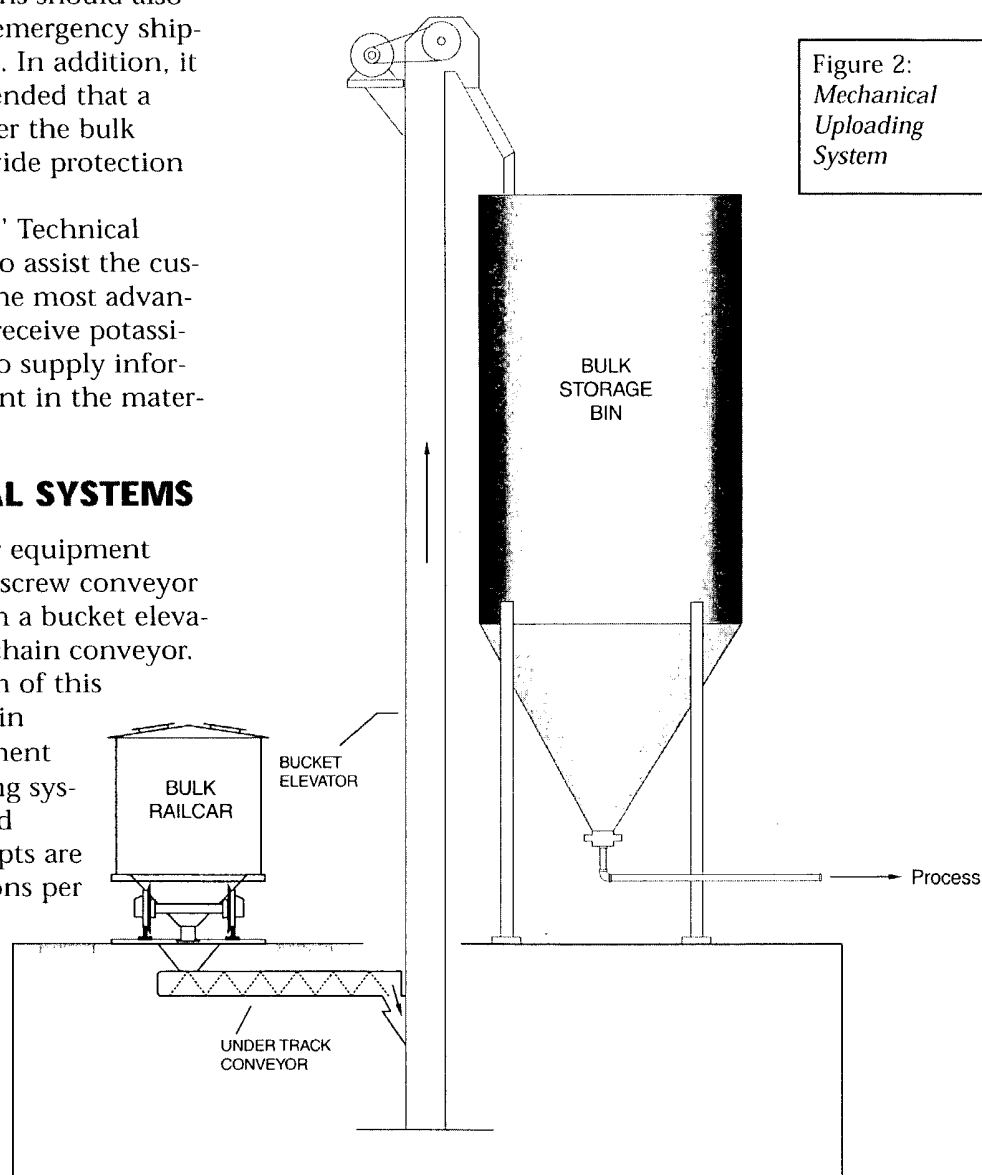


Figure 2:
Mechanical
Uploading
System

increases particle degradation. In many cases where particle size is important for granular potassium carbonate, the use of a screw conveyor should be avoided if possible.

Lubricants would contaminate the potassium carbonate due to the location of bearings in the screw conveyor. Therefore, either white iron or Stellite bearings is recommended. The outboard bearing drive end of the conveyor should be located outside the trough to decrease maintenance and increase bearing and drive life. Discussion with an equipment manufacturer regarding the capacity, size and r.p.m. of screw conveyors would facilitate better potassium carbonate service.

The **belt conveyor** is recommended primarily where large tonnage is to be conveyed long distances. The initial expense and horsepower requirements of belt conveyors are quite low. Particle degradation is kept to a minimum where belt conveyors are used. They can be used to convey up, down or on an incline at a maximum operating angle of 10° for potassium carbonate. All bearings and idlers on a belt conveyor for potassium carbonate should be antifriction and dust-proof. Discussion with an equipment manufacturer regarding the capacity, size and r.p.m. of screw conveyors would facilitate better potassium carbonate service.

Although dusting and contamination may become excessive at loading and discharge points, the use of special housings will overcome this problem. Where wind or moisture presents a serious problem, the increased cost of weather-tight housing may increase the total investment above that required for other types of conveyors.

A **bucket elevator** consists of an endless rubber belt or chain to which are attached buckets for elevating material vertically or along steep inclines. It has a receiving hopper or boot and provisions for discharging the load. For potassium carbonate service, the rubber belt type is preferred to the chain type thereby avoiding metallic contamination. Loading should be on the vertical leg rather than forcing the bucket to scoop the material from the boot. The added cost of a deeper elevator pit required for vertical loading will be offset by a much smoother and continuous operation.

There are three general types of bucket elevator discharges: centrifugal, continuous and positive. The **centrifugal elevator** discharges material by centrifugal force, operating at high speeds to assure that the buckets empty completely and to prevent the "backlogging" or recycling of material. Some particle degradation of granular potassium carbonate occurs due to the centrifugal force used to fling the material into the discharge chute.

The **continuous elevator** is designed for slow speed operation and ordinarily should not exceed 125 feet per minute. Its buckets are mounted continuously so that material is discharged from one bucket over the front of the preceding one which acts as a moving chute or guide to the fixed discharge spout. The continuous elevator has a higher initial cost when compared to a centrifugal elevator. However, its slower speed causes less wear on buckets, belts and wheels, translating into a lower maintenance cost.

Although the continuous elevator operates at slower speed than

the centrifugal, it has about the same capacity because of the greater number of buckets. The continuous elevators are especially well adapted where degradation of material is to be minimized and where extreme dust conditions are to be avoided.

The **positive discharge bucket elevator** is also designed for slow speeds of approximately 120 feet per minute. The interval spaced buckets are completely inverted by snubbing the chains after they have passed over the head pulley, giving them an opportunity for complete discharge. Since the positive discharge elevator is a low-capacity unit for the cost involved, it does not replace the centrifugal or continuous elevators in normal granular potassium carbonate service.

The **continuous flow conveyor** is a unit which carries materials en masse through a dustproof and weathertight duct, completely filling its cross section. In general, the conveyor medium is an endless chain upon which are mounted flights at suitable intervals or a chain with the flight cast as an integral part of the link. The flights can be either solid or open finger type. The conveyor can operate on a horizontal, vertical or incline plane and in any combination thereof. Speed is usually limited to about 80 feet per minute, although slower speeds are preferred. Because the conveyor is completely enclosed and lubrication points can be located outside the unit, the material conveyed is not subject to external contaminations. The conveyor is not completely self-cleaning, so where more than one material is handled, contamination could become a problem. When handling deliquescent materials like potassium carbonate, special care is required to remove any residual material between product trans-

fers.

Another type of en masse conveyor is known as the "zipper". It consists of a flat, endless rubber belt with two attached side belts designed to fold into a semi-circular enclosure. The outer edges of the side belts are made with rubber teeth which interlock when the conveyor is closed. It is dust-tight and will handle granular potassium carbonate without degradation.

C. PNEUMATIC CONVEYING

The pneumatic conveyor differs altogether from other machines in that it depends on a high velocity air stream to transport materials. If the velocity is too low, the material will drag and build up, particularly on long horizontal runs and in elbows. The pneumatic conveyor is higher in capital investment and power cost than a mechanical conveying system. Some product degradation can be expected, however, the extent of particle breakage is nominal for Armand Products' dense granular potassium carbonate when the system is properly operated. Advantages that help offset its high cost include dust suppression, flexibility, low handling losses and self-cleaning. Dry air must be used in the pneumatic transfer of potassium carbonate when moisture pickup is detrimental and also where the humidity factor is high.

There are three types of pneumatic conveying systems: vacuum, pressure and combination vacuum-pressure.

With a proven record of efficient performance for low cost unloading of bulk cars, the **vacuum system** is especially effective in picking up material from many points and delivering to one remotely located

process or storage area. Hook-up of a bulk rail car and startup of the system is quickly and easily done.

The vacuum type pneumatic unloading system requires little accessory equipment. The system consists of a transport pipe attached to an adapter mounted on the Enterprise gate of the hopper car. Approximately 20 feet of flexible pipe should be available to make the proper connection to the car.

The transport pipe delivers potassium carbonate to a receiver above the storage bin where the air and potassium carbonate are separated. The air is exhausted to the atmosphere through a dust filter or preferably a bag house while the potassium carbonate is discharged through an airlock into storage. A blower on the exhaust side of the separator or dust collector provides vacuum in the system. The suction system is capable of transporting potassium carbonate economically for distances up to 500 feet.

The **pressure system (Figure 3)** is an economical, compact system, for transferring product from one area to several points, frequently at considerable distances. This system is extremely flexible and can be adapted to many specific needs including unloading, in-plant transfer and recirculation.

Pressure type pneumatic systems usually require additional equipment at the inlet end of the transport pipe. Generally, a blower or fan is used to furnish compressed air which is forced into the line through an injection nozzle. In a modified version of the system, potassium carbonate is fed by screw conveyor into an air stream which carries the potassium carbonate to storage. Another pressure system utilizes a fluidization chamber,

where a predetermined volume of potassium carbonate is dropped into the vessel, fluidized under pressure and blown through the line. This unloading method is an intermittent and cyclic operation.

The **combination vacuum-pressure (Figure 4)** is considerably more sophisticated. Combining features of both types described above, this system expands the range of usage and is capable of meeting multiple needs. Stationary or portable systems can be operated under push-button control. Railcars can be unloaded simultaneously from various sidings with simultaneous delivery to many points, without contamination and at a high volume throughput.

Potassium carbonate can be transported a considerable distance by this combination system. This also eliminates the inlet equipment necessary for a straight pressure system. Although the unloading distance can be extended over that of a suction system, the power requirements are likely to be excessively large for the longer application.

Figure 3:
Pressure
System

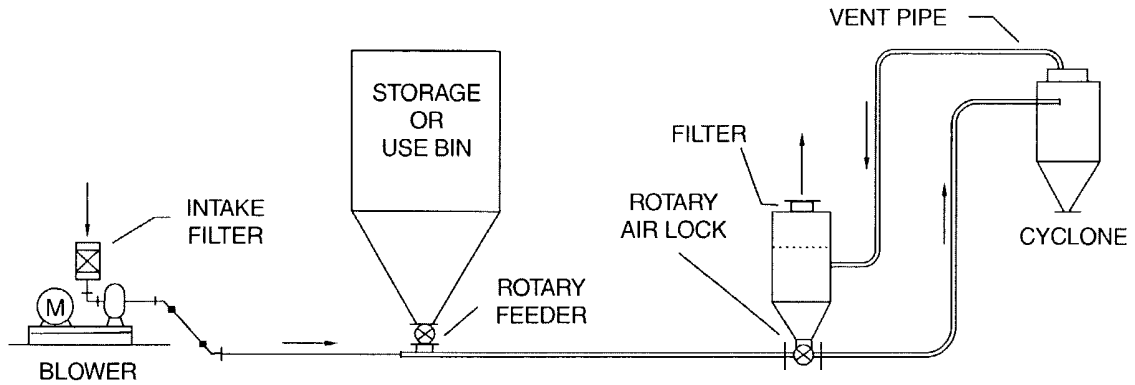
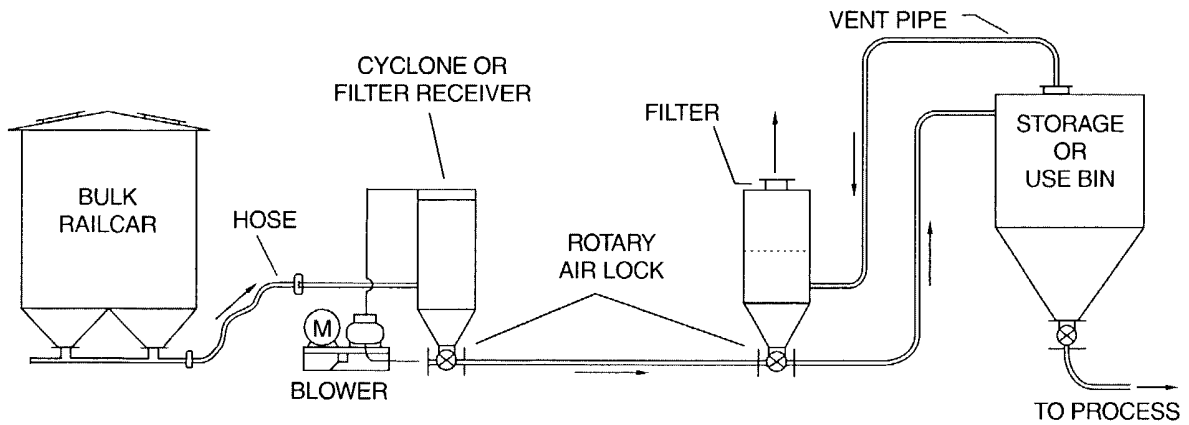


Figure 4:
Combination
Vacuum-
Pressure System



D. BULK STORAGE

Storage facilities for potassium carbonate can be constructed of concrete or steel. A moisture seal is required to eliminate penetration of water which both contaminates the product and causes it to lump. Storage capacity should be at least 1.5 to 2 times the amount of potassium carbonate received in a single shipment. This safety factor insures an adequate supply of potassium carbonate at all times and allows for unforeseen transportation delays. Storage bin capacity should be calculated on a basis of 82 lbs./cu. ft. for Armand Products' granular potassium carbonate. Bins may be cylindrical with cone bottom or rectangular with V-slanted bottoms. The slopes of the bin bottoms should be approximately 45 degrees.

Prefabricated storage bins offer the most economical and versatile choice for bulk storage of potassium carbonate. These bins are readily available in a variety of sizes and shapes with galvanized, black or stainless steels as the common materials of construction. The standard vertical types are cylindrical with the bottom designed for either center or side draw-off. They are easily assembled in the field on their own supports with the assistance of the vendor or may be assembled directly by the customer. They must be made weatherproof to protect the potassium carbonate from moisture.

Concrete silos are of three types: stave, monolithic or poured, and block or tile. The stave type is lowest in cost and is formed of precast concrete staves, set up in stepped

tiers and bonded with outside turn-buckle rods. The interior walls are plastered for a smooth surface, and the exterior is brush-coated with waterproof cement. Cone bottoms are easily adapted to this type of silo. Monolithic silos are of poured concrete with circumferential reinforcing steel. Concrete block and hollow tile silos are more expensive than either the stave or monolithic. Block silos are formed with chambered precast concrete blocks, and hollow tile silos are of precast chambered tile with reinforcing rods grouted into recesses between the tiers. Care should be exercised when choosing a silo of this last design.

A vent dryer is recommended for all dry bulk potassium carbonate storage facilities. A typical dryer for this application can be fabricated by the customer or purchased from a vendor.

IX. Handling of Liquid Potassium Carbonate

A. SHIPMENTS OF 47% POTASSIUM CARBONATE

Liquid 47% potassium carbonate is typically shipped in drums, tank truck or rail car. It is also available by consignment as a barge load, shipped from the Armand Products' plant in Muscle Shoals, AL. Each form of transportation has its own advantages. The type of service you select will depend upon such factors as size and location of storage, rate of consumption, plant location and freight rates. Armand Products' Technical Service staff is well qualified to survey your present facilities and recommend the economical form of transportation best suited to your particular requirements.

The unloading and handling of 47% liquid potassium carbonate is simple. The freight for transporting this solution is higher than for the granular, anhydrous form. It is necessary to have enough tank capacity to accommodate a 16,000 gallon rail shipment or a 4,000 gallon tank truck shipment in addition to whatever level of inventory the customer maintains.

B. UNLOADING LIQUID POTASSIUM CARBONATE FROM TANK CARS

Placement of Railcar for Unloading

- 1** DOT requires setting the handbrake and blocking the wheels after the car is properly spotted.
- 2** DOT regulations also state that caution signs must be placed on the track or car to give warning to persons and switching crews approaching the car from the open end(s) of the siding. Caution signs must be left up until the car is empty and disconnected from the unloading line. Signs must be made of metal or other suitable material, at least 12 x 15 inches in size, and bear the words, "Stop - Tank Car Connected" or "Stop - Men At Work".
- 3** Place derail attachments at the open end(s) of the siding, approximately one car length (50 ft.) away.

Unloading Precautions

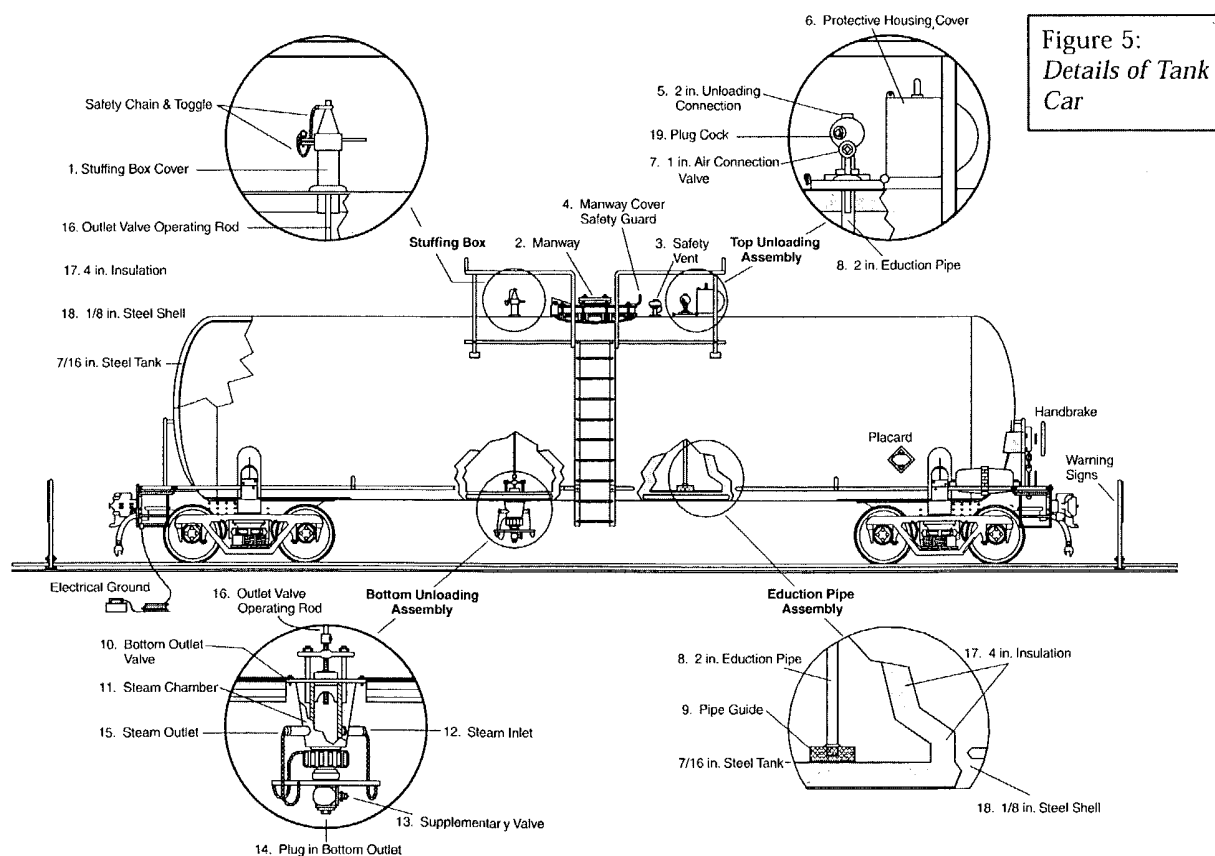
- 1** Entrust only responsible and well-supervised employees with the unloading of liquid potassium carbonate. It is recommended that a worker be present during the entire time that a car is being unloaded.
- 2** Provide workers with chemical splash goggles, hard hats, and rubber or rubber coated gloves to protect against eye and skin exposure. A safety shower and eyewash fountain must be located in the unloading area.
- 3** Unload only in daytime or when adequate lighting is available. Caution workers to exercise care.
- 4** Before starting to unload, make certain that the tank car and storage tank are vented and verify that the storage tank has sufficient capacity for the delivery.
- 5** Do not allow entry into the car under any circumstances.
- 6** If the tank car needs to be moved when partially unloaded, DOT regulations require disconnecting all unloading lines and replacing all car closures.

- 7** A suggested method for sampling is to withdraw intermittent samples from a 1/2 inch sample line fitted with a valve and 1/4 inch nipple which is connected to a vertical portion of the unloading line.
- 8** Armand Products' liquid potassium carbonate is shipped in well insulated and specially lined tank cars. Linings in these liquid tank cars will withstand temperatures up to 225°F. To prevent damage to the linings, steam should not be added directly into the tank cars under any circumstances.
- 9** If compressed air (20 psig max.) is used in the unloading operations, inspect all fittings for leaks or other defects before unloading. Dome fit-

tings should be inspected carefully. If leaks are found, suspend unloading operations until they are fixed.

Handling in Cold Weather

Under normal weather conditions, 47% liquid potassium carbonate will remain fluid. Since Armand Products' liquid PotCarb is loaded hot into well insulated tank cars, this product should arrive at the destination in a liquid state. Under severe winter conditions, 47% potassium carbonate will begin to crystallize below 8°F. Although frozen material has not presented a problem in the past, the Technical Service staff is available for assistance should such a situation occur.

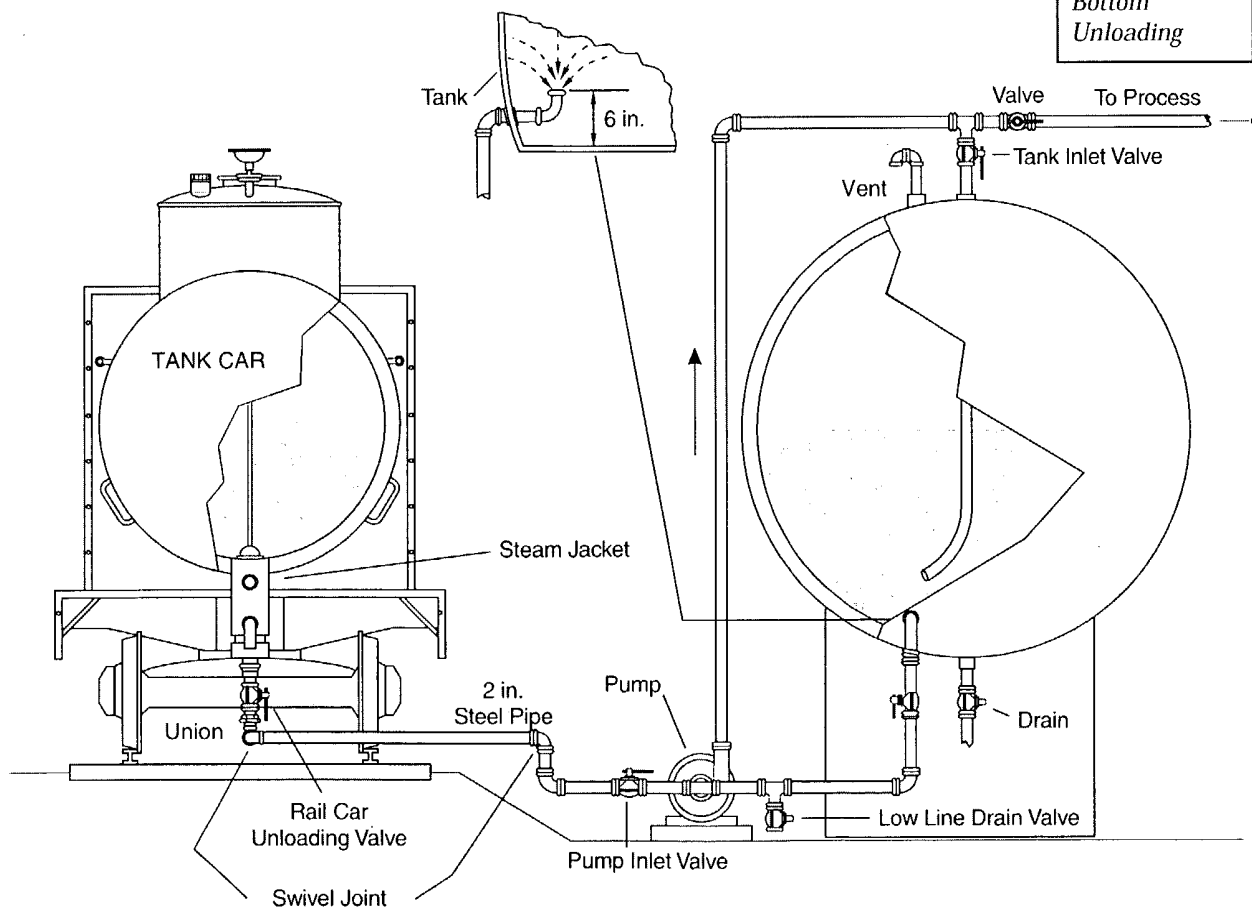


Unloading through Bottom Outlet Valve (Figures 5 and 6)

Liquid potassium carbonate is usually unloaded through the bottom outlet valve. Most cars are also equipped with eduction pipes that allow for unloading through the dome if desired. Both methods are described in this handbook.

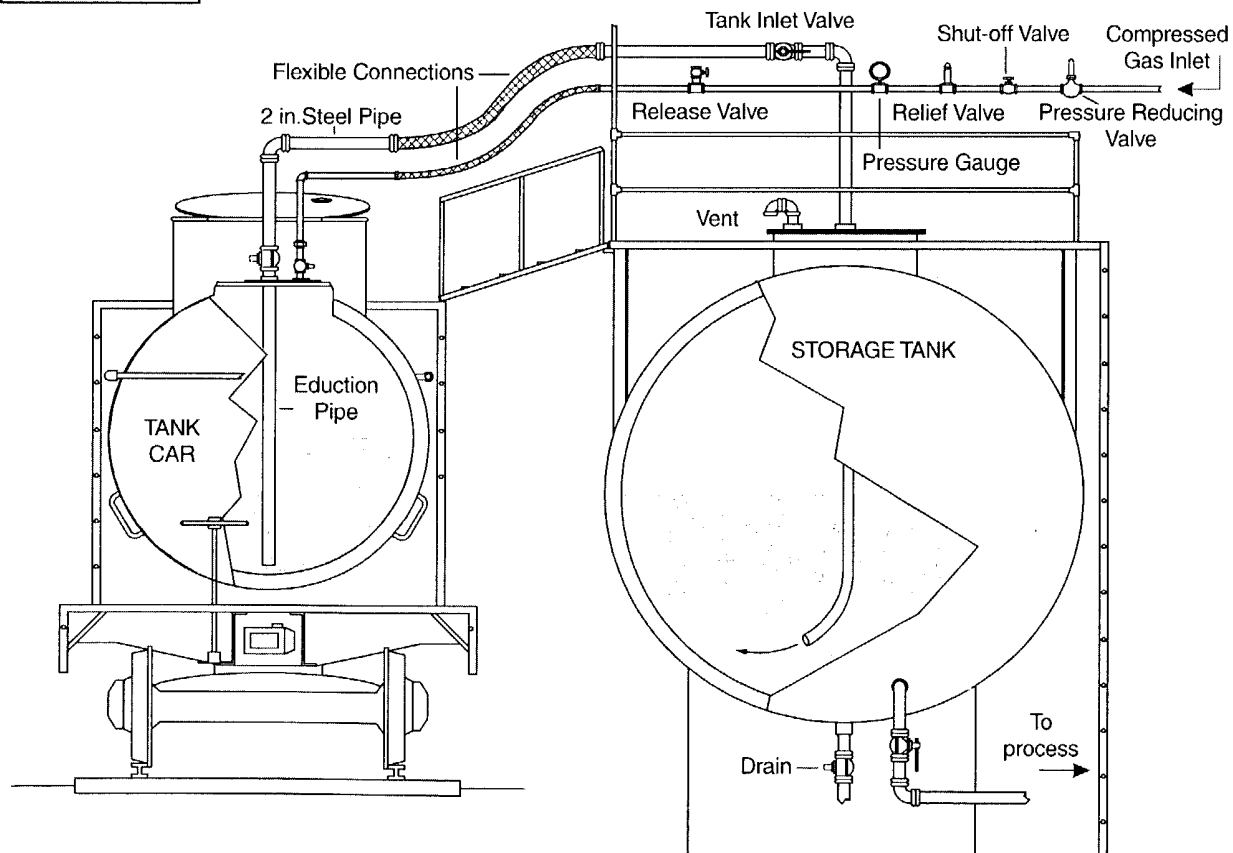
- 1 Open the dome cover and ascertain whether the contents of the car are liquid. Keep the dome cover at least partially open during the entire unloading operation to vent the tank car. This prevents a vacuum from being created in the car.
- 2 Ensure that the bottom outlet valve (10) Figure 5 is closed
- 3 Remove the pipe plug (14) and then carefully open supplementary valve (13) in order to drain out any liquid into a bucket that may have seeped by the bottom outlet valve (10) during transit. If the supplementary valve cannot be opened, apply steam from a steam lance on the valve's exterior to free it for opening.

Figure 6:
Bottom
Unloading



- 4** Attach the unloading line to the outlet side of supplementary valve.
- 5** Check the unloading line to see that all valves are in the proper position for unloading.
- 6** Open the bottom outlet valve by turning valve rod (16) to allow contents to flow by gravity to pump or tank.
- 7** Compressed air can be used to speed up the flow or to transfer the liquid to the storage tank without the use of a pump. Check that the rupture disk is intact. The pipe plug on the air connection valve (7) must be removed and a flexible air line connected for this purpose. This line should be equipped with a release valve, oil trap, pressure relief valve set at 20 psig, pressure reducing valve set at 18 psig and a shutoff valve. When using compressed air to assist in the transfer of product, the dome cover should be securely closed before the application of air pressure.
- 8** When the car and unloading line are empty, shut off the air supply and open the release valve if air pressure has been used in unloading.
- 9** Detach the unloading line at the car after the following conditions are met: tank car is empty and at atmospheric pressure; discharge pipe has completely drained; and if used, air line is disconnected. Prepare car for returning according to procedure under "Preparing Empty Cars For Return."

Figure 7:
Top
Unloading



**Top Unloading with Air Pressure
(Figures 5 and 7)**

- 1** Open the dome cover and ascertain that the contents of the car are liquid. Check that the rupture disk is intact.
- 2** Close the dome cover and fasten securely, making certain that it is airtight.
- 3** Check storage tank to see that it has sufficient capacity and is well vented. Removal of cover on top of storage tank is advisable for venting.
- 4** Connect the unloading line to a 2-inch unloading connection (5) on the eduction pipe, after removing cover (5). A flexible steel hose connection for unloading is recommended since the car may rise of as much as two inches during unloading.
- 5** Connect the flexible air supply line to the 1-inch air inlet valve (7, Figure 6). This line should be equipped with a release valve, oil trap, pressure relief valve set at 20 psig, pressure reducing valve set at 18 psig and a shutoff valve.
- 6** Apply air pressure slowly until there is a normal flow of liquid to the storage tank, after which the pressure should be adjusted and maintained until the tank car is completely empty. The sound of air rushing through the unloading line and a drop in air pressure indicates that the tank car is empty.
- 7** When the unloading line is empty, shut off air supply, open the release valve and allow the discharge pipe to drain well.

- 8** After proper draining and with the tank car at atmospheric pressure, disconnect the air supply line at the railcar.
- 9** Open the manway cover and determine whether the car is empty, however, do not enter the railcar to make an inspection. If the car is empty, only then should the unloading line be disconnected. Replace manway and valve covers tightly.
- 10** Take care not to spill any product on the car as it will endanger trainmen handling the empty car on its return and may cause damage to the car.
- 11** Prepare car for return as highlighted in the following section.

Preparing Empty Tank Car for Return

- 1** Close bottom outlet valve and supplementary valve.
- 2** Disconnect the unloading line and replace the bottom outlet plug. Do not replace closures on steam openings.
- 3** Close the dome cover and fasten securely.
- 4** Return the empty tank car promptly in accordance with the shipper's instructions. Follow the shipper's routing directions in all instances.

C. UNLOADING LIQUID POTASSIUM CARBONATE IN TANK TRUCKS

The transportation of 47% liquid potassium carbonate is accomplished in 4,000-gallon tank trucks meeting DOT regulations. The consignee should determine if sufficient tank capacity is available to accept the shipment. Any special instructions concerning the delivery must be conveyed by the consignee to the truck driver before permission is given to unload. Each truck driver is completely familiar with the equipment used and under normal unloading conditions does not require manpower assistance from the consignee. However, it is always a good idea to have a consignee operator near the unloading area. Customers are asked to report any problems that result from the carrier failing to follow proper unloading procedures as well as any personal protective gear or specified safety requirements.

Tank trucks containing liquid potassium carbonate are commonly unloaded by one of three methods:

Gravity

Flow of material direct to storage or to an unloading pump furnished by the consignee.

Truck Mounted Pump

Tank truck equipment is available which has an all iron or nickel pump mounted on the tank truck. The pump is driven by a tractor powered take-off or an auxiliary gasoline engine. At least a 2-inch pump line should be used. If this type of unloading is desired, arrangements should be made with

your Armand Products Company sales representative at the time of your original order.

Compressed Air

Unloading by air pressure is another option where the consignee can provide the air supply system. Equipment on the air supply line to the truck includes: pressure reducing valve (PRV), pressure gauge, pressure relief valve (set 2-3 psi above PRV setting) and a pressure release valve. All associated equipment should be properly maintained and periodically tested. An air hose of appropriate length to reach the truck dome is required if the customer's air supply is used.

Another option is to request that the carrier come equipped with a self-contained air compressor system mounted on the truck. If this is the desired unloading mechanism, arrangements should be made through your Armand Products' salesperson at the time of your original order.

Tank Truck Unloading Facilities

- 1 An eye wash and safety shower should be located nearby and periodically tested. If these are not available then clean, potable water flowing through a hose must be readily accessible.
- 2 A storage tank of 6,000 gallons capacity is suggested to provide adequate capacity for typical tank truck shipments and a sufficient reserve supply between shipments. **Figure 8** provides general information on both horizontal and vertical tanks for storage of truck

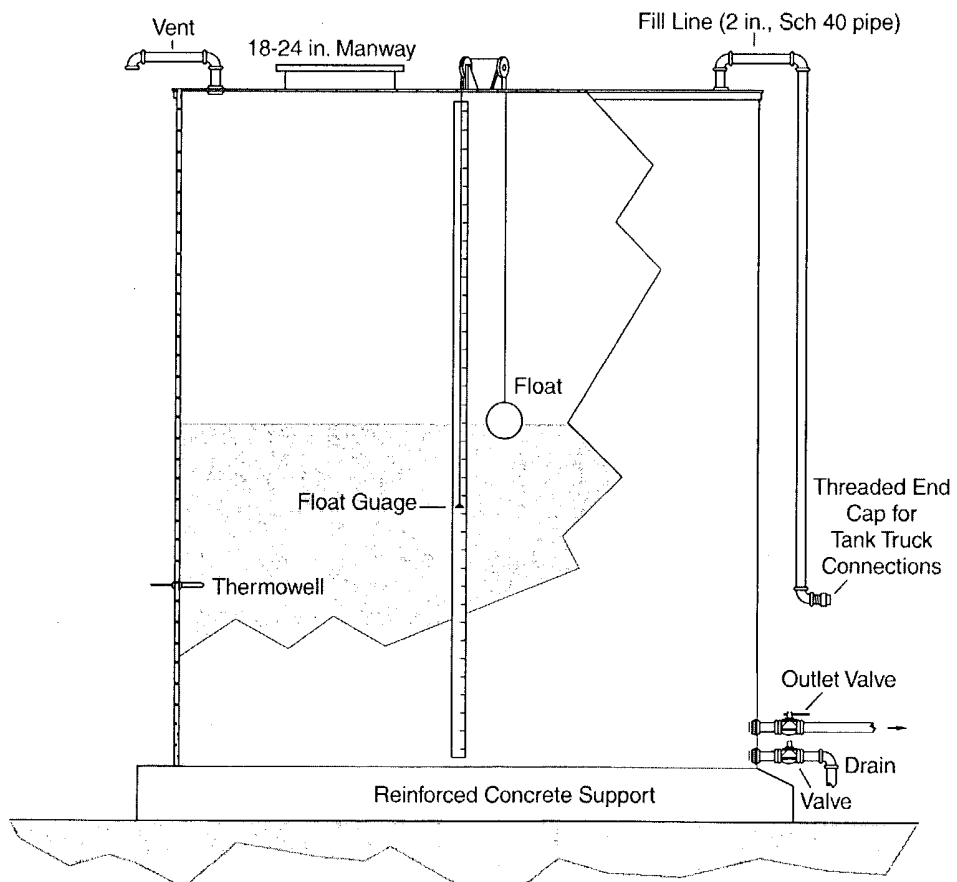
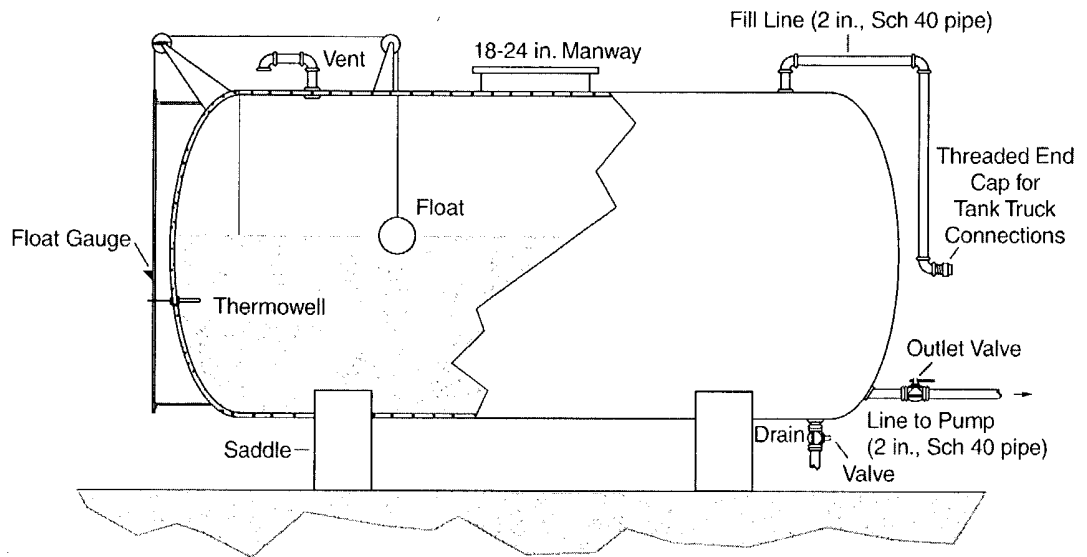
shipments. Steam coils are not required for these tanks except in those areas where the temperature will drop below 10°F for extended periods of time. In fringe areas, insulation of the tank should suffice.

- 3** A permanent 2-inch unloading line from a convenient truck unloading area to the top of the storage tank should be installed. Connection between the truck and the permanent unloading line is furnished through the use of an alkali-resistant heavy duty rubber hose carried on the truck. The distance should be measured to determine the appropriate length required on the truck.
- 4** The permanent unloading line should be equipped with a 2-inch male pipe fitting (kam-lock type) to facilitate connecting the rubber hose from the tank truck. Cap the end of the permanent unloading line when not in use.
- 5** A $\frac{3}{4}$ inch valve connection is recommended on the unloading line at the truck end for use in flushing out the line with air, water or steam. It can also be used as a drain.

Unloading Procedure

- 1** Purge out the eye wash and shower to remove rust that may have accumulated.
- 2** Connect one end of the unloading hose to the customer's storage tank fill pipeline.
- 3** Depending on the severity of the cold weather, the fill line, the unloading hose or truck outlet may need to be pre-heated with steam.
- 4** Check the unloading line to be sure that it is open.
- 5** Connect the unloading hose to the discharge outlet on the tank truck.
- 6** Start the pump or start pressurizing the truck tank depending on the type of equipment used.
- 7** Open the valves on the truck discharge line.
- 8** Monitor in person the entire unloading process until the truck is empty.
- 9** If compressed air is used, allow the air to flush out the lines to the storage tank and then cut off the air supply.
- 10** When a pump is used, it is advisable to flush out the unloading line before disconnecting the hose. If water is available, a small quantity can be added to the truck while the pump is running to flush out the line. Air or water can be used to flush out the line into the storage tank. If no water is available or incomplete flushing is suspected, great caution should be exercised when disconnecting lines.
- 11** Close the valve on the storage tank fill line.
- 12** Close all valves on the tank truck.
- 13** If the customer's fill line is fitted with a drain, this should be disconnected and any residue discharged into a proper container.
- 14** Unload potassium carbonate with adequate safeguards for spill control. Proper containment and disposal of released product should be handled in accordance with federal, state and local regulations.

Figure 8:
Installation of
Tanks for
Liquid Product



D. DILUTION OF POTASSIUM CARBONATE SOLUTION

The references to various tables and figures will provide important data for the dilution of an aqueous solution of potassium carbonate:

Table 4, page 36 - weight of potassium carbonate solutions at 60°F; used in calculating and estimating capacities of process equipment.

Table 5, page 37 - density of a potassium carbonate solution as a function of temperature and concentration.

Graph 1, page 40 - dilution chart for 47% potassium carbonate with water at 60°F.

Graph 2, page 41 - dilution chart for various concentrations of potassium carbonate with water at 60°F.

Graph 3, page 42 - gross weight in pounds per gallon of potassium carbonate solution including its density at 60°F.

Dilution Calculations

The matter of diluting liquid potassium carbonate to a given concentration is frequently confusing. Dilutions can be simplified to the following formula:

$$A \times (B - C) / C = D$$

A = Specific Gravity of Strong Solution

B = % K_2CO_3 in Strong Solution

C = % K_2CO_3 in Weak Solution

D = Volume of water to add to each volume of strong solution.

Example 1

Dilution of 47% liquid potassium carbonate to 15% potassium carbonate solution:

Specific Gravity of 47% liquid at 60°F = 1.496 (from Table 4)

Thus, $[1.496 \times (0.47 - 0.15)] / 0.15 = 3.19$ volumes of water to add to each volume of 47% liquid potassium carbonate.

It should be noted that volumes of potassium carbonate solutions and water are not additive. When one gallon of water and one gallon of potassium carbonate solution are mixed, the resultant yield is somewhat less than two gallons. This fact is quite significant when dealing with large volumes.

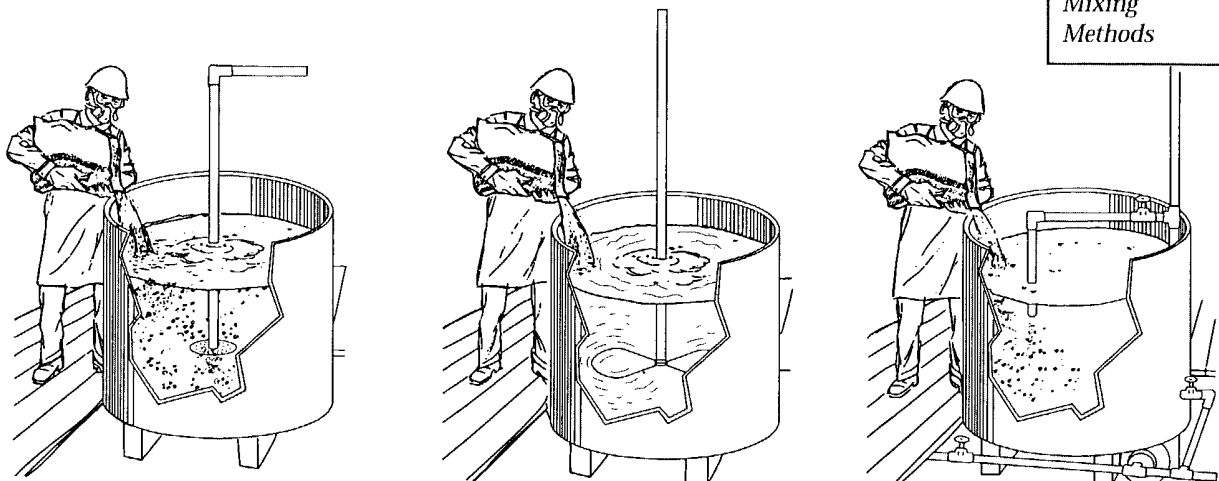


Figure 9:
Alternative
Mixing
Methods

Example 2(using **Graph 2**)

To make a 100 gallon solution containing 2.5 pounds K_2CO_3 per gallon, two solutions containing 1.5 and 6.0 pounds of K_2CO_3 per gallon are used. The volume of each solution is determined by drawing the line "AB" connecting 1.5 lbs./gal. with the 6.0 lbs./gal. This intersects 2.5 lbs./gal. at point "C". Reading down to the "Volume of Water or Weak Liquor" we find 77 gallons (1.5 lbs./gal.). Next, reading up to the "Volume of Strong Liquor Used" we find 23 gallons (6.0 lbs./gal.).

DISSOLVING ANHYDROUS POTASSIUM CARBONATE

Anhydrous potassium carbonate is readily soluble in water. When large quantities of granular potassium carbonate are placed in quiescent solutions, the granular material falls to the bottom and forms a layer of hydrate. This layer dissolves quite

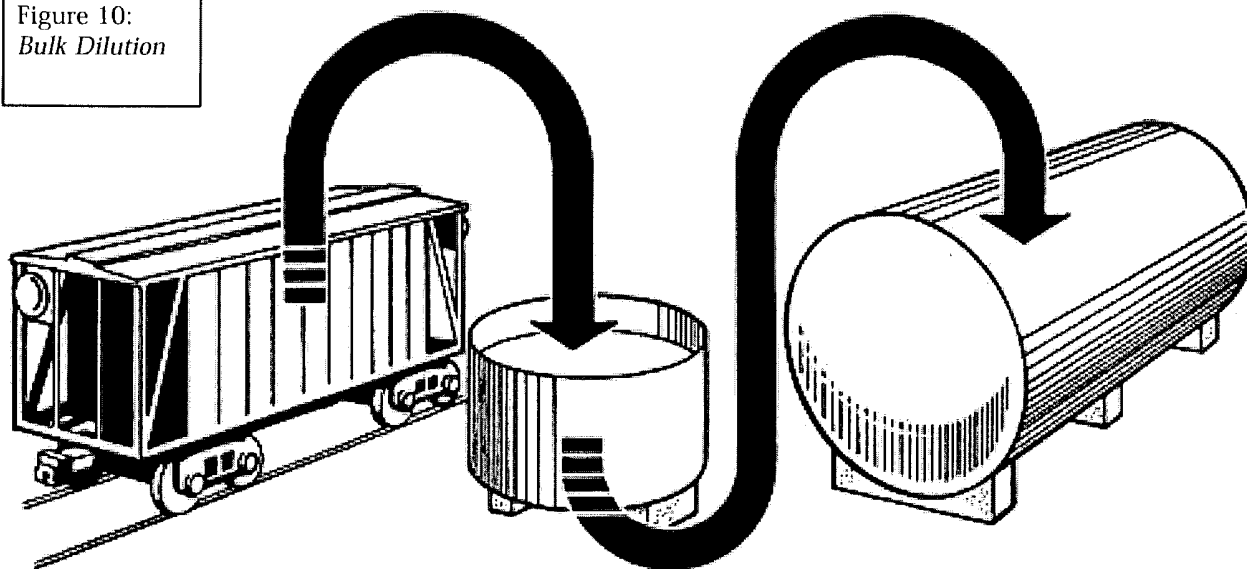
slowly, forming an area of heavy concentration. There also is local overheating which may cause an attack on the tank lining or coating.

Good practice calls for slowly adding the granular material to a well agitated solution of water (see **Figure 9**). Agitation is best supplied by a propeller type agitator, or under some conditions, by using a circulating pump.

SOLUTION STORAGE WITH DRY BULK DELIVERY

A user of potassium carbonate in solution form may want to explore another possibility. Bulk trucks of anhydrous material can allow the dissolution of the PotCarb in water as it is transferred to the storage tank (see **Figure 10**). With pneumatic truck delivery, anhydrous potassium carbonate is discharged into a slurrifier located on top of the storage tank. The slurrifier is a pipe held in vertical position with dry material added at the top and

Figure 10:
Bulk Dilution



solution added tangentially to the pipe with the resultant slurry discharged from the bottom of the pipe into the top of the storage tank. Dissolving of the potassium carbonate is completed in the storage tank. A vent on the storage tank is required to let the anhydrous PotCarb transport air escape. Armand Products' Technical Service is available for discussion should the customer consider such a system.

The slurrier system works best with a hot solution (140-190°F). This helps to insure that the potassium carbonate dissolves rapidly and minimizes any problem of solids build-up in the tank bottom. The dissolving rate is approximately doubled when the temperature of solution is raised from 60°F to 150°F. A considerable amount of heat is evolved in the charging process due to the heat of solution. For a 30% solution, a temperature rise of 35°F will take place.